DOCUMENT RESUME

ED 165 790 IR 006 860

AUTHOR	Crawford, Alice M., Ed.; And Others
TITLE	Evaluation of a Computer-Based Course Management System. Final Report.
INSTITUTION	Illinois Univ., Urbana.
SPONS AGENCY	Navy Personnel Research and Development Center, San Diego, Calif.
REPORT NO	NPRDC-TR-79-3
PUB DATE	Oct 78
GRANT	N-61339-73-C-0078
NOTE	33p.
EDRS PRICE	MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS	*Computer Managed Instruction; *Course Evaluation; Economic Education; Higher Education; *Management Systems; Summative Evaluation; Textbooks
IDENTIFIERS	*Computer Assisted Testing; *PLATO

ABSTRACT

This project evaluated a Course Management System (CMS), which was developed at the University of Illinois and implemented on the PLATO IV instructional system during two semesters of an introductory level economics course. The CMS was designed to integrate books, computer testing, and personnel utilization in applying instructional and computer technology to the management of large-scale instruction, while minimizing online computer use and costs, and materials preparation costs. The performance of the experimental and control groups on the final examination and the responses to a questionnaire measuring attitude provided the primary bases for evaluating the effectiveness and adequacy of the CMS. Results of these measures are discussed, and recommendations are offered for the individualization of computer managed standard courses. (Author/RAO)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED165790

U S DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

NPRDC TR 79-3

October 1978

EVALUATION OF A COMPUTER-BASED COURSE MANAGEMENT SYSTEM

Alice M. Crawford
William E. Montague
Beatrice M. Smith

Editors

This research was supported jointly by the Advanced Research Projects Agency of the Department of Defense and the Navy Personnel Research and Development Center and was monitored by NPRDC under Contract No. N61339-73-C-0078.

The views and conclusions contained in this document are those of the editors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the DoD Advanced Research Projects Agency.

Reviewed by
John D. Ford, Jr.

Approved by
James J. Regan
Technical Director

Navy Personnel Research and Development Center
San Diego, California 92152

IR006860

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NPRDC TR 79-3	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) EVALUATION OF A COMPUTER-BASED COURSE MANAGEMENT SYSTEM		5. TYPE OF REPORT & PERIOD COVERED Final Report January 1974-June 1975
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Alice M. Crawford William E. Montague Editors Beatrice M. Smith		8. CONTRACT OR GRANT NUMBER(s) N61339-73-C-0078
9. PERFORMING ORGANIZATION NAME AND ADDRESS University of Illinois Urbana, Illinois 61801		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62757N ZF55.522.002.01.60
11. CONTROLLING OFFICE NAME AND ADDRESS Navy Personnel Research and Development Center San Diego, California 92152		12. REPORT DATE October 1978
		13. NUMBER OF PAGES 33
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Report is a condensed version of a longer report (unpublished) submitted by the contractor in 1975.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Computer-based Instruction
Individualized Instruction
Course Management
Instructional Technology

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The research reported on the evaluation of a computer-based course management system in a college economics course. Students acquired course information from individual reading while the computer maintained attention to the material and monitored progress. Results indicated that the course management system had facilitated the study of text and that student attitudes regarding the system were favorable. From these results it is concluded that this procedure may hold considerable promise for increasing the efficiency

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

of military training. It is relatively easy, and therefore inexpensive, to prepare questions covering instructional materials, and the self-pacing of progress saves student time and releases instructors for important instructional interaction with students. Therefore, it is recommended that tests of the procedures be carried out in military settings to determine the feasibility of using the procedure with military students.

FOREWORD

This research and development was conducted through a contract with the University of Illinois under Exploratory Development Task Area ZF55.522.002 (Methodology for Developing/Evaluating Navy Training Programs), Work Unit Number 01.60 (Advanced Computer-Based Research). It was jointly funded by the Advanced Research Projects Agency and the Navy Personnel Research and Development Center. Work was initiated in response to the requirement for "improvements in training methodologies, measurement techniques, management and administration, including decision critiera required for their rapid implementation" (GOR 43, Rev 10/71). The basic rationale for the R&D was developed in a proposal submitted by Dr. Richard C. Anderson during the Fall of 1972 and a follow-on proposal in the Fall of 1973.

An extensive final report was submitted by the contractor in 1975. Persons involved in research for and authorship of this report are listed below:

Dr. Thomas H. Anderson
Dr. Richard C. Anderson
Mr. Stephen M. Alessi
Dr. Bruce R. Dalgaard
Dr. Donald W. Paden
Mr. W. Barry Biddle
Mr. John R. Surber
Dr. H. Richard Smock

The final report was extensively modified and condensed by Ms. Alice Crawford, Dr. William Montague, and Mrs. Beatrice Smith of NAVPERSRANDCEN. Dr. Montague also served as the technical contract monitor for this effort.

J. J. CLARKIN
Commanding Officer

SUMMARY

Problem

Students often fail to learn from books and other instructional sources because they do not study them carefully enough. Additionally, managing the large groups of students being trained in university and military settings entails considerable logistics problems. These issues are related to problems of applying modern instructional and computer technology to the management of large-scale instruction while minimizing on-line computer use and costs and material preparation costs. The research reported here, the final in a series of studies, addresses these problems.

Purpose

The purpose of the project was to evaluate (experimentally) the computer-based Course Management System (CMS), which was designed to integrate books, computer testing, and personnel for training. At the core of the CMS is a computer-assisted instruction study management system (CAISMS), which was developed and evaluated in earlier research. CAISMS was designed to question students intermittently about what they are reading to maintain deep cognitive processing.

Approach

The system was implemented on the PLATO IV instructional system at the University of Illinois during two semesters of an introductory level economics course. The first semester served primarily as a trial implementation in which procedures were established, computer programs were debugged, etc. In the second semester, a group of 360 experimental students received instruction through the CMS. These students acquired concepts and information from individual reading while CAISMS maintained their attention to the material and monitored their progress. A control group of 70 students was taught by a traditional lecture-discussion format, but used the same text and took the same final test as the experimental group. The instructor time that was not needed for the experimental students was invested in remediation and special interest seminars. The two groups were compared on final exam performance and attitudes toward the training.

Findings

Analysis of final exam data showed that, when type of test questions was examined, the experimental group performed better than the control group on text-related items; and the control group, on lecture-related items. The groups did not differ on items selected from a standardized test.

Student reactions to the computer-assisted instruction and the seminars were favorable. However, it was found that the seminars could overburden some of the students, particularly if course-imposed deadlines were not implemented to maintain their progress through the textual material.

Conclusions

It was concluded that the CMS had facilitated the study of text, and that student attitudes regarding the system were favorable. The computer was effective for managing students, keeping records, and providing direct communication and interaction between student and instructor.

The seminars were implemented smoothly, and appeared to achieve the purpose of making economic theory more understandable via practical situations.

Recommendations

It is recommended that CMS be implemented in a military setting to establish usable techniques that will permit Navy operational training personnel to modify standard courses, to ascertain developmental costs, and to determine the effectiveness of the system using military students.

CONTENTS

	Page
INTRODUCTION	1
Problem	1
Background	1
Purpose	3
METHOD	5
Subjects	5
Apparatus	5
Procedure	5
Measuring Student Performance	6
Determining Student Attitudes	7
RESULTS AND DISCUSSION	9
Student Performance	9
Student Attitudes Toward the Computer-based Course	11
Student Attitudes Toward Seminars	13
CONCLUSIONS	21
RECOMMENDATIONS	23
REFERENCES	25
DISTRIBUTION LIST	27

LIST OF TABLES

		Page
1.	Summary of CMS Research and Development at the University of Illinois	4
2.	Performance of Second Semester Experimental and Control Students	9
3.	Correlations of Predictor and Achievement Variables	10
4.	Standardized Multiple Regression Weights Between Predictor and Achievement Variables	10
5.	Standardized Canonical Regression Weights of Predictors and Achievement Variables	11
6.	Open-Ended Responses Provided by Second Semester Experimental Students on Seminar Approach	13
7.	Responses Provided by CAISMS Students on Seminar Evaluation Questionnaires	15
8.	Disproportionate Cell Frequencies Analysis of Variance on Results of Seminar Evaluation Questionnaires	17
9.	Results of Comparison Between Types of Seminars	20

INTRODUCTION

Problem

Navy training has typically been conducted using traditional classroom techniques. Group lectures are presented, students are assigned study textbooks, and infrequent examinations are given. However, textbooks are often ineffective because students do not spend enough time studying them. Further, the lecture, the traditional means of educating large nubmers of students in university and military settings, is typically dull, ineffective, and inefficient (Lloyd, Garlington, Lawry, Burgess, Evler, & Knowlton, 1972). Also, managing large numbers of students in such settings entails considerable logistics problems.

The fact that a course can be successful without lectures has been clearly established. In a recent comprehensive review of instructional techniques, it was shown that students under individualized instruction consistently scored higher than those under traditional lecture or lecture-discussion methods (Parsons, undated). More specifically, in a study of Navy training, it was found that, by using individualized instruction instead of standard classroom instruction, training time required was reduced by about 50 percent (Carson, Graham, Harding, Johnson, Mayo, & Salop, 1975).

A Course Management System (CMS) has been developed that provides individualized instruction to students enrolled in large classes. Typically, the use of individualized instruction requires that course materials be completely redeveloped because of changed requirements. However, in the design of CMS, an attempt was made to minimize the material development effort required by integrating the use of textbooks, computers, and live instructors. If experimental evaluation of this system proves to be successful, a means will be provided for converting standard group-lecture type courses to an individualized format, while minimizing the developmental efforts required.

Background

CMS has evolved from a series of research and development efforts beginning with the development of a computer-assisted instruction study management system (CAISMS), which was implemented and evaluated in previous research (Alessi, Anderson, Anderson, Biddle, Dalgaard, Paden, Smock, Surber, & Wietecha, 1974; Anderson, Anderson, Dalgaard, Paden, Biddle, Surber, & Alessi, 1975a).

The rationale behind the development of CAISMS was that learning from text involves a series of student-initiated processing activities that seldom are fully effective because of conditions prevailing in large courses. There is a range of evidence available that shows that procedures that induce meaningful processing of text facilitate learning (e.g., Barclay, 1973). Further, the results of 75 years of research indicate that asking people questions about what they are doing is an effective way of managing processing activities (Anderson & Biddle, 1975). This was the technique integrated into CAISMS.

The system was implemented on the PLATO IV instructional system at the University of Illinois with an introductory level economics course. Terminals were installed in the library so that student operators could be near an environment in which they could study. The instructional procedure involved a student signing in on the terminal, receiving an assignment, studying the material in the nearby workspace, signing in again, and receiving a quiz covering the reading materials. If the student's quiz score was 75 percent or more, he could progress to the next assignment and go through the cycle again. If his score was less than 75 percent, he was directed by CAISMS to review the same study assignment and retake the quiz. The quiz scores did not affect the student's final grade, but he had to pass a certain number of them before he could take the final exam. This contingency made it almost impossible for students to go into the exam unprepared.

The quiz items were developed to measure how well the student comprehended the important concepts in the text, as judged by the economist subject matter experts on the project team. They either paraphrased the language in the text, or required the student to apply concepts and principles to examples other than those appearing in the text. These types of items increase the probability that the student will engage in meaningful cognitive processing (Watts & Anderson, 1971; Felker, 1974).

During the Fall semester of 1973, the feasibility of CAISMS was tested as a supplement to the standard lecture and discussion sections. A group of 75 students was asked to interact with PLATO IV terminals to receive all reading assignments. Performance was evaluated by the scores the students obtained on the quizzes and the off-line examinations. At the end of the semester, questionnaires were administered to determine student attitudes toward use of CAISMS. Results indicated that the system was feasible to administer and potentially effective in producing achievement gains over traditional types of instruction. Further, it was rated favorably by a majority of the students (Alessi et al., 1974; Anderson, Anderson, Dalgaard, Wietecha, Biddle, Paden, Smock, Alessi, Surber, & Klemt, 1974).

CAISMS was experimentally evaluated during the Spring semester of 1974 (Anderson, Anderson, Dalgaard et al., 1975a and b). Approximately 200 students were randomly assigned either to classes using CAISMS or to control classes using traditional methods. All classes had a seminar lecture discussion format, used the same textbook, and received an identical battery of achievement tests and questionnaires during the semester. Results indicated that members of the CAISMS classes scored higher on achievement tests than members of the control classes. Further, the attitudes of CAISMS students regarding their method of instruction were more positive than those of the control students. Attrition rates were approximately equal in the two groups.

The Course Management System (CMS) was designed in the Summer of 1974 and implemented for feasibility testing during the Fall semester of that year (Anderson, Anderson, Alessi, Dalgaard, Paden, Biddle, Surber, & Smock, 1975a and b). In CMS, students are expected to acquire basic information and concepts primarily from individual reading. Their attention to the material is maintained and their progress monitored by the previously developed CAISMS. Since lectures and standard quiz sections are not included in CMS, instructors can devote their time to providing remedial

feedback for students having trouble in mastering core curriculum and to teaching seminars. The role of the computer (PLATO IV) was to manage study behavior, to administer on-line achievement tests, to provide a message exchange system for students and instructors, and to schedule group tutorial and seminar sessions.

The concept of using seminars as a supplement to computer-assisted instruction was developed during the early stages of CMS. The idea was that students should be provided with an in-depth look at one or more areas of practical economics. In other words, a minicourse would be developed that would allow students to explore an economic problem in some detail. During this exploration, they would use their economic skills developed through their work with the textual aspects of the course to investigate an economic problem (also see Dalgaard, Paden, & Anderson, 1976).

Five instructors were selected from the teaching staff to select the topics of the seminars, to develop course materials and procedures, and to teach the seminars.

During the Fall semester of 1974, a group of 360 students used the CMS while procedures were being established and the computer programs were being debugged. Ten seminars, covering a variety of topics ranging from Environmental Economics to Consumerism, were offered several times during the semester. They were 4 weeks in length, with two 1-hour meetings held each week. A small class size was maintained (10 to 15 students), and seminar performance counted as one-third of the course grade. CMS feasibility was established, and achievement tests showed that students using CMS performed as well as previous students who had been instructed under traditional classroom methods (Anderson, Anderson, Alessi et al., 1975a).

Table 1 presents a chronological summary of the project and identifies the relevant documentation.

Purpose

The present effort is a continuation of that reported by Anderson, Anderson, Alessi et al., 1975a. Its objective was to evaluate experimentally the effectiveness of the CMS within a university setting where large numbers of students are available. It is expected that the use of CMS will provide substantial reductions in efforts required to develop individualized courses and in costs of operating large courses, as well as increased effectiveness in terms of both learning time required and performance.

Table 1

Summary of CMS Research and Development
at the University of Illinois

Item	Semester			
	Fall 1973	Spring 1974	Fall 1974	Spring 1975
Research Phase	Implementation and feasibility test of CAISMS	Experimental evaluation of CAISMS	Implementation and feasibility test of CMS	Experimental evaluation of CMS
Relevant Documentation	Development and implementation of the Computer-Assisted Instruction Study Management System (CAISMS) (NPRDC TR 74-29). Alessi, S. M., Anderson, R. C., Anderson, T. H., Biddle, W. B., Dalgaard, B. R., Paden, D. W., Smock, H. R., Surber, J. R., & Wietecha, E. J.	An experimental evaluation of a Computer-Assisted Instruction Study Management System (CAISMS) (NPRDC TR 75-31). Anderson, T. H., Anderson, R. C., Dalgaard, B. R., Paden, D. W., Biddle, W. B., Surber, J. R., & Alessi, S. M.	A multifacted computer-based course management system (NPRDC TR 75-30). Anderson, T. W., Anderson, R. C. Alessi, S. M., Paden, D. W., Biddle, W. B., Surber, J. B., & Smock, H. R.	Present report

METHOD

Subjects

A total of 780 undergraduate students enrolled in the introductory level economics class at the University of Illinois participated in the project. This number included the 360 students enrolled in the Fall semester of 1974 (previously described under Background) and 420 students enrolled in the Spring semester of 1975. Of the latter group, 350 were assigned to the experimental group and 70, to the control group. However, due to normal attrition, a total of only 373--319 in the experimental group and 64 in the control group--took the final performance examination and was included in the final analyses.

In subsequent sections, the Fall semester of 1974 will be referred to as the first semester; and the Spring semester of 1975, as the second semester. For both semesters, all students used the same introductory economics text--Samuelson, Economics (9th edition), 1973.

Apparatus

The economics course was managed for all students in the first semester and the experimental students in the second semester by the PLATO IV instructional system. This system consists of a Control Data Corporation Cyber 73 computer and a number of remote terminals, which include a keyset and a display panel that looks like a television screen. Students can relay messages to the computer via the keyset and receive messages from the computer via the display panel. In most instances, the response is immediate. Detailed information on this system is provided by Stifle (1972a, 1972b, 1973).

Procedure

All students in the first semester and the experimental students in the second semester were instructed by the CMS on the PLATO system (CAISMS). These students were given assignments in the text by the computer. When they finished these assignments, they were required to take short practice quizzes from PLATO to determine whether they comprehended the material. A total of 63 quizzes was given, covering specific sections in 27 chapters of the text. Although the student's final grade was not influenced by the grades he received on the quizzes, he was required to complete the appropriate quizzes in sequence before getting his next assignment. Moreover, if he received poor grades on the quizzes, he was obligated to seek help from a teaching assistant or a tutor (undergraduate economic majors assigned to help teaching assistants).

After the CAISMS student had passed a specific number of short quizzes, he was notified by the computer that he was eligible to take a 1-hour graded examination. Three of these exams were administered by PLATO during the semester. To assist the student in preparing for these exams, a large number of review items had been prepared that were similar in format and language to those on the test. The student had free access to these

items after he had become eligible to take the exam. The computer would display a random sample of 10 items to the student, provide feedback (correct or incorrect) immediately after the student had answered an item, and summarize the student's performance after he had answered all 10 items. Students could try as many samples of items as they wished before taking the exam.

When a graded exam had been completed, the computer immediately provided the grade obtained to the student, as well as his cumulative record and standing in the course. He could then go on to the next assignment and go through the process again. By using CAISMS, students could progress at their own pace. It was possible for them to complete the course in as little as 12 weeks.

At some time during the semester, CAISMS students were required to select at least one seminar on topics of current interest. For those seminars requiring specific analytical skills, satisfactory progress to a particular point in the text was a prerequisite. The computer provided scheduling information for these seminars, as well as for remedial sessions.

As indicated previously, the seminars were 4 weeks in length, with two 1-hour meetings per week, and included from 10 to 15 students. Most seminars in both semesters were taught by the same five instructors who had developed them; the remainder were taught by student tutors and other faculty members. However, in the first semester, seminar performance counted as one-third of the final grade; and in the second semester, as one-fifth. Also, since students in the first semester appeared to be falling behind in studying their text, deadlines in completing text work were imposed for the second semester to ensure that students maintained their progress toward course completion. These deadlines also meant that students almost always entered a seminar just after completing a section of the course leading to a 1-hour graded exam. As a result, some seminars during the second seminar (10 of 22) were held on an irregular basis rather than meeting continuously for 4 weeks.

The 70 control students in the second semester were taught by the same instructors who were responsible for the experimental students, but without the assistance of CMS. They interacted with the instructor in a lecture-discussion setting, and were given the same assignments and 1-hour graded exams as the experimental students. However, they did not take the numerous short quizzes on specific parts of the text nor were they able to participate in seminars. Rather, they were exposed intensively to only one topic--the Economics of Inflation.

Measuring Student Performance

As indicated previously, the performance of students using CMS in the first semester was based on scores obtained in the course examination.

For the second semester, the performance of both the experimental and control groups was measured by the scores obtained on a final examination containing 70 items. Of this number, 30 items were text related (TEXT), 30 were selected from standardized items from a test prepared by the Joint

Council on Economic Education (JC), and 10 were interpretive exercises (IE) designed by the instructors. Also, for all second semester students, data were obtained regarding their high school percentile rank, credit hours completed in the undergraduate program, undergraduate grade point average, and student class standing (e.g., freshman).

Determining Student Attitudes

Near the end of the second semester, experimental group students were administered a questionnaire via PLATO. Questions were asked regarding their attitudes toward the course and computer-assisted instruction. For each question presented on the screen, students selected that alternative which most closely reflected their attitude toward the particular topic presented.

As part of the procedures to determine the effectiveness of the seminars, experimental group students in both semesters were administered paper-and-pencil evaluation questionnaires at the end of each seminar. In addition, during the second seminar, experimental group students were administered course evaluation questionnaires via PLATO. These questionnaires included questions designed to elicit student attitudes toward the individual seminars and the instructors who conducted the same seminars both semesters, and provided an opportunity for making open-ended comments. Questions concerning instructors were included to determine any interactions between instructors and semesters.

RESULTS AND DISCUSSION

The performance of the experimental and control groups on the final examination and their responses to the questionnaires provide the primary bases for evaluating the effectiveness and adequacy of the Course Management System (CMS).

Student Performance

Table 2 provides the mean scores obtained by second semester experimental and control students on the text related (TEXT), standardized Joint Council on Economic Education (JC), and interpretative exercise (IE) items. As shown, the experimental group scored significantly higher on the TEXT items; and the control group, on the IE items. There was no significant difference between the two groups on the standardized JC items.

Table 2

Performance of Second Semester Experimental and Control Students

	TEXT Items (30)		JC Items (30)		IE Items (10)		Total	
Group	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Experimental (N = 319)	20.45	3.55	20.52	4.11	6.19	1.83	46.52	7.84
Control (N = 64)	18.86	4.15	20.01	4.98	6.97	2.25	45.43	9.79
Experimental vs. Control	$t = 3.2$, $p < .002$		$t = .87$, $p < .38$		$t = -2.99$, $p < .003$		$t = .84$, $p < .41$	

Since students had not been randomly assigned to experimental and control groups, regression analyses were performed to correct for possible between-group differences. Table 3 shows the means and correlation coefficients between the three achievement variables (i.e., scores obtained on TEXT, JC, and IE items) and the five predictor variables (i.e., high school percentile rank (HSRANK), cumulative hours in undergraduate degree program (HOURS), undergraduate grade point average (GPA), student year in school classification (CLASSIF), and treatment group (experimental or control) (TREAT)). The most striking feature of the data pattern shown in Table 3 is the consistently high positive correlation between measures of GPA and the three achievement variables.

Table 3

Correlations of Predictor and Achievement Variables

Variable	Mean	Correlation Coefficients							
		1	2	3	4	5	6	7	8
1. HSRANK	84.2	1.0							
2. HOURS	47.3	.04	1.0						
3. GPA	3.85	.42	.05	1.0					
4. CLASSIF	1.7	-.05	.70	.15	1.0				
5. TREAT	1.8	.00	.30	-.06	-.36	1.0			
6. TEXT	20.2	.32	.01	.55	.11	.16	1.0		
7. JC	20.4	.28	.05	.56	.13	.05	.67	1.0	
8. IE	6.3	.26	.15	.40	.21	-.13	.42	.47	1.0

Note. Number of students = 367.

Table 4 shows the standardized multiple regression weights obtained when the five predictor variables were used simultaneously to predict each of the achievement variables. The multiple regressions for predicting TEXT, JC, and IC are .61, .58, and .45 respectively. The predictor variable that contributes most to the prediction scheme for each of the three achievement variables is GPA. Thus, knowledge of how well a student performed in other courses is the best predictor of how he performed in the introductory economics class. The second best predictor on the TEXT variable was TREAT, or knowledge of whether the student belonged to the experimental (CMS) or control group.

Table 4

Standardized Multiple Regression Weights
Between Predictor and Achievement Variables

Predictor Variables	Achievement Variables		
	TEXT	JC	IE
HSRANK	.13	.07	.14
HOURS	-.08	-.07	.00
GPA	.49	.51	.32
CLASSIF	.18	.17	.14
TREAT	.23	.12	-.06
Mult R =	.61	.58	.45

Finally, Table 5 shows results from the canonical regression when all predictor and achievement variables were considered simultaneously. Two statistically significant regression equations evolved. The standardized regression weights from the first equation indicate that GPA, CLASSIF, and TREAT are the best predictors for the three achievement variables, which all had weightings in the same direction. This equation quantifies the relationship between GPA and the other predictors; it shows that GPA is about 2.5 times more powerful than any other variable used in this prediction system for predicting overall exam performance.

Table 5

Standardized Canonical Regression Weights
of Predictor and Achievement Variables

	Predictor					Achievement		
Equation	HSRANK	HOURS	GPA	CLASSIF	TREAT	TEXT	JC	IE
1	-.20	.11	-.84	-.30	.25	-.56	-.42	-.18
2	.17	.21	-.02	.09	-.86	-.81	.14	1.01
3	.99	.19	-.67	.22	.31	.94	-.13	.51

Equation 1, χ^2 = 134.26, df = 15, p < .0001; R_c = .65

Equation 2, χ^2 = 17.88, df = 8, p < .03 ; R_c = .27

Equation 3, χ^2 = 1.84, df = 3, p < .25 ; R_c = .09

Equation 2, which represents another way of weighting these variables to produce a "reliable" prediction system, shows another relationship among the variables. First, TREAT is by far the most powerful predictor and second, TEXT and IE are the two achievement variables of record. This relationship indicates that knowledge of whether the student belonged to the experimental or control group is a useful predictor of performance on TEXT and IE, in a correspondingly inverse direction. The sign on the weightings shows that membership in the experimental group (TREAT = 2) results in higher TEXT scores and lower IE scores than membership in the control group (TREAT = 1). This makes sense, when considering the fact that the Course Management System was designed to facilitate study of the text material, and that the control group received training in working on the types of items in the IE section of the test.

Student Attitudes Toward the Computer-based Course

As indicated previously, only 319 of the original 350 experimental students in the second semester completed the course. These students were administered a course evaluation questionnaire via PLATO. The responses to the five items listed below are of particular interest. As shown, their attitudes were quite favorable.

1. How do you rate the course in general?

Excellent or very good	99
Good	123
Fair	86
Poor or very poor	11
	319

2. Would you take another course taught this way?

Strongly agree	74
Agree	129
Disagree	67
Strongly disagree	49
	319

3. The practice quizzes on PLATO were:

Very important/helpful	48
Important and helpful	207
Neither important or helpful	63
Did not use	1
	319

4. The opportunity to retake examinations was:

Very important/helpful	157
Important and helpful	92
Neither important/helpful	21
Did not use	49
	319

5. Everything considered, do you prefer:

On-line examinations	191
Pencil-and-paper tests	81
No preference	47
	319

The marked preference of students to take on-line examinations indicated in item 5 should be interpreted in light of the circumstances associated with CAI testing. The advantages of on-line examinations include instant grading, the opportunity to retake the tests, and multiple testing times. The disadvantages include machine malfunctions, time pressure, and the inability to return to test questions.

In this regard, it is interesting to note that 61 of the 319 experimental students elected to take the final examination prior to the end of the semester. The fact that able students may finish early may be an advantageous feature for future applications of CAI in which time savings are of interest. Finally, students indicated that they spent on an average of 4.6 hours per week studying for the course.

Student Attitudes Toward Seminars

The students generally supported the seminars that were designed to aid in teaching economic concepts. As indicated previously, seminars were evaluated after each seminar and at the end of the second semester using the course evaluation questionnaire. Students were asked to rate the seminars on a five-point scale. Results are provided in Table 6.

Table 6

Open-Ended Responses Provided by Second Semester Experimental Students on Seminar Approach

Topic	Number	Means[a]	S.D.
Concept of Seminar	42	3.143	1.424
Grading Procedure:			
Weight in Course	7	2.000	1.000
TA Approach	8	2.000	0.000
Workload	7	1.714	0.488
Instructor	12	1.917	1.084
Content/Organization of Seminar	10	2.600	0.966
Length of Seminar	7	2.286	0.756
Specific Seminar	23	2.783	1.622
	116		

[a]Rated on a 5-point scale, with 1 meaning highly unfavorable and 5, highly favorable.

As shown in Table 6, the concept of the seminar as an aid to understanding received the highest rating--3.143. However, since this rating was obtained only from second semester students, it is probably lower than it might have been during the first semester, because the instructors reduced the grade value of the seminars from one-third to one-fifth of the final grade. In spite of this, 66 percent of the students reported that the seminars had been "very helpful or very important" or "important and helpful."

The seminar evaluation questionnaires administered to students after each seminar were designed to evaluate both materials and instructors. Instructor ratings were made on eight variables; student grades provided a ninth. Although additional seminars were taught each semester by student tutors and other faculty members, they were not evaluated.

Mean responses provided by students in both semesters are provided in Table 7. The first eight variables were rated on Likert-like scales, with lower ratings usually being more favorable than higher ratings. The ninth variable reflects student performance.

Table 8 provides results of an analysis of variance for disproportionate cell frequencies. As shown, differences between semesters were significant for variables labeled course content, course in general, comparative interest, and progress in course. For each significant difference, the first semester was rated more favorably than the second semester, except for instructor number 5, for variables labeled course content and progress in course.

A number of intangible factors may have been responsible for these significant differences between semesters. For example, instructor interest waned somewhat during the second semester. As a result, students did not find cause to rate the instructor lower, the course more difficult, or the workload more excessive, but they were less satisfied with the course content in general, found it less interesting, and made less progress. Note that, in all cases, students rated the seminar less interesting in the second semester (Table 8). Perhaps even more significant, however, and this may also have affected the instructors, was the fact that the importance of the seminar had been played down considerably during the second semester. With seminars given less weight and thus less importance, students may well have found it less appealing and interesting. The important factor in receiving a good course grade was the text material; seminar performance was not vital. This point was further supported by the responses to the question regarding the importance of and request for open-ended comments on seminars included in the PLATO-administered exam given to experimental students in the second semester. Students rated the concept of the seminar quite highly, but reacted more negatively to the seminar weight, workload, and length (see Table 6).

Returning to Table 8, we find that differences between instructors were significant for variables labeled major instructor, difficulty level, comparative interest, and seminar grades. Table 7 shows that, while instructors 1 and 3 fared better in terms of overall instructor rating and comparative interest, they were not rated as the instructors offering the least difficult seminars or higher grades. Since these findings show that students did not rate instructors highly because of easy seminars or easy grading, it appears that there were significant differences between instructors, in spite of the similarity in preparation provided by training sessions. These differences might be due to differences in teaching experience--instructors 1 and 3 entered the project with 5 years of training experience; and the other three, with 1/2 year to 2 years of experience.

Table 7

Responses Provided by CAISMS Students on Seminar Evaluation Questionnaires

Instructor Code	Means	
	Fall Semester	Spring Semester
Course Content (Seminar)[a]		
1	2.372	2.770
2	2.673	2.777
3	1.943	2.577
4	2.597	3.245
5	2.643	2.595
Major Instructor (Seminar)[a]		
1	1.944	2.380
2	2.353	2.600
3	1.813	2.033
4	2.940	2.965
5	2.644	2.528
Course in General (Seminar)[a]		
1	2.312	2.810
2	2.685	2.820
3	2.170	2.583
4	2.735	3.373
5	2.798	2.783
Difficulty Level[b]		
1	2.840	2.383
2	2.295	2.370
3	2.283	2.343
4	2.670	2.540
5	2.234	2.568
Work Load[c]		
1	3.102	2.583
2	2.790	2.350
3	3.018	2.977
4	3.068	2.533
5	2.718	3.075

[a]Rated on a 6-point scale, with 1 meaning excellent and 6, very poor.

[b]Rated on a 4-point scale, with 1 meaning very difficult and 4, very easy.

[c]Rated on a 5-point scale, with 1 meaning excessive and 5, very light.

Table 7 (Continued)

Instructor Code	Means	
	Fall Semester	Spring Semester
	Comparative Interest[d]	
1	1.156	1.623
2	1.640	1.923
3	1.338	1.453
4	1.712	2.098
5	1.512	1.845
	Progress in Course[e]	
1	1.632	2.223
2	1.615	1.823
3	1.915	2.057
4	1.852	2.410
5	1.920	1.895
	Class Participation[f]	
1	1.120	1.277
2	1.230	1.417
3	1.133	1.173
4	1.182	1.170
5	1.064	1.063
	Seminar Grades[g]	
1	7.394	6.277
2	6.753	5.567
3	7.442	7.297
4	7.577	7.665
5	7.328	7.230

[d]Rated on a 3-point scale, with 1 meaning more interesting and 3, less interesting.

[e]Rated on a 3-point scale, with 1 meaning yes (I am getting behind in my textbook) and 3, no (I am not getting behind).

[f]Rated on a 3-point scale, with 1 meaning yes (I had sufficient opportunity to discuss and ask questions) and 3, no (I did not have sufficient opportunity).

[g]Reflects mean score obtained by CAISMS students.

Table 8

Disproportionate Cell Frequencies Analysis of Variance
on Results of Seminar Evaluation Questionnaires

Source	df	MS	F	p
Course Content (Seminar)				
Instructor	4	0.4214	1.66	0.185
Semester	1	1.1202	4.40	0.044*
Interaction (I x S)	4	0.1740	0.68	0.609*
Error	31	0.2545		
Major Instructor (Seminar)				
Instructor	4	1.2231	5.35	0.002*
Semester	1	0.2574	1.13	0.297
Interaction (I x S)	4	0.0887	0.39	0.815
Error	31	0.2284		
Course in General (Seminar)				
Instructor	4	0.5059	1.95	0.127
Semester	1	1.0844	4.19	0.049*
Interaction (I x S)	4	0.1398	0.54	0.708
Error	31	0.2591		
Difficulty Level				
Instructor	4	0.1659	2.87	0.039*
Semester	1	0.0054	0.09	0.763
Interaction (I x S)	4	0.1672	2.89	0.038*
Error	31	0.0578		
Workload				
Instructor	4	0.1960	1.13	0.361
Semester	1	0.5410	3.12	0.087
Interaction (I x S)	4	0.2929	1.69	0.178
Error	31	0.1735		
Comparative Interest				
Instructor	4	0.4160	3.35	0.022*
Semester	1	0.9792	7.88	0.009*
Interaction (I x S)	4	0.0337	0.27	0.894
Error	31	0.1242		

*$p < .05$

Table 8 (Continued)

Source	df	MS	F	p
		Progress in Course		
Instructor	4	0.1721	1.06	0.395
Semester	1	0.8473	5.20	0.030*
Interaction (I x S)	4	0.1415	0.87	0.494
Error	31	0.1630		
		Class Participation		
Instructor	4	0.0686	1.70	0.176
Semester	1	0.0536	1.33	0.258
Interaction (I x S)	4	0.0164	0.41	0.803
Error	31	0.0404		
		Seminar Grades		
Instructor	4	2.5701	3.59	0.016*
Semester	1	2.3552	3.29	0.079
Interaction (I x S)	4	0.7229	1.01	0.417
Error	31	0.7156		

*$p < .05$

In seminar developmental sessions, an attempt was made to equalize the difficulty level and workload and to standardize grading procedures. The staff was successful in equalizing the workload, since Table 8 shows no significant differences on this variable. However, as mentioned above, there were significant differences in difficulty level and seminar grades. The former might stem, to a certain extent, from the concepts dealt with by seminars. The latter can be attributed almost exclusively to instructor 2, who graded considerably lower than the others. Thus, it can be stated, with some reservation, that the staff was successful in making these seminars fair in relation to the equalization of difficulty level and workloads and standardization of grading procedures.

An issue that is very interesting, especially in terms of the applicability of these seminars to other courses, was that entitled progress in course. This variable was included to determine whether students felt they were getting behind in their text work because of the seminars, which met at the same time as they were working through the core material. Table 7 distinctly shows that students in the first semester, whose responses tend toward "yes," felt they were getting behind more than those in the second semester, whose responses tend toward "no." This finding is significant in light of changes in seminar scheduling implemented during the second semester. As indicated previously, to ensure that students maintained progress toward completion of their work, deadlines were imposed. As a result, students almost always entered a seminar just after completing a section of the course leading to a 1-hour graded exam. This meant that some seminars met on an irregular basis rather than regularly over a 4-week period. Table 9 provides the results obtained when the two types of seminars were compared along the nine variables in question. As shown, the only significant difference between the two types was in the variable labeled progress in text. Thus, it appears that students felt they were further behind in their work when there was no course-imposed discipline than when there were deadlines. It is not clear whether or not the seminar caused the students to fall behind; they may have been behind all along. In any event, when one considers the student responses, it seems that the concentrated seminar does put a burden on the students. Deadlines help to keep them from falling behind, but the added workload of a 4-week seminar does impose a burden.

In concluding this section, it is important to stress a general student approval of seminars. They proved to be a vital aspect of the CMS, by providing students with a more concentrated, practical orientation than the traditional haphazard "outside readings." Also, the idea of using seminars as a part of the introductory survey courses is appealing to students who often find difficulty in applying theoretical concepts. Although the exact nature of the seminar presentation is, to a large extent, dictated by the structure of the course, results of this study tend to prove that seminars are worthwhile and deserve further utilization and study.

Table 9

Results of Comparison Between Types of Seminars

Type	Means	t	df	p
	Course Content[a]			
Split Seminars	2.889	1.325	.8	.20
Continuous Seminars	2.543			
	Seminars in General[a]			
Split Seminars	3.003	1.421	18	.17
Continuous Seminars	2.638			
	Difficulty Level[b]			
Split Seminars	2.523	1.363	18	.24
Continuous Seminars	2.362			
	Work Load[c]			
Split Seminars	2.747	0.124	18	.90
Continuous Seminars	2.780			
	Interest Level[d]			
Split Seminars	1.869	1.435	18	.17
Continuous Seminars	1.619			
	Progress in Text[e]			
Split Seminars	2.323	2.498	18	.03*
Continuous Seminars	1.839			

[a]Rated on a 6-point scale, with 1 meaning excellent and 6, very poor.

[b]Rated on a 4-point scale, with 1 meaning very difficult and 4, very easy.

[c]Rated on a 5-point scale, with 1 meaning excessive and 5, very light.

[d]Rated on a 3-point scale, with 1 meaning more interesting and 3, less interesting.

[e]Rated on a 3-point scale, with 1 meaning yes (I am getting behind in my textbook) and 3, no (I am not getting behind).

*$p < .05$

CONCLUSIONS

The CMS, with minimal help from the instructors, was as effective as the more traditional classroom techniques. It is essential to note that the computer was being used not so much as an instrument of instruction, but as a director and monitor of student progress. As has been demonstrated repeatedly in courses using self-paced instruction, students can master subject matter "on their own," although typically with a high dropout rate, an unknown amount of energy expended on their part, and a great deal of work on the part of the instructor. As used in this experiment, the computer was an effective device for managing students, for keeping records, and for providing direct communication and interaction between student and instructor.

The strategy adopted in this experiment of systematically quizzing students over standard text material required a relatively small commitment of staff time to programming (see Allessi et al., 1974) and a relatively small investment of student time in interaction with the computer (about 1 hour each week). Student reaction to the numerous small quizzes, the three computer-administered hour examinations, and the course in general was favorable.

What is perhaps of greater significance is that the time saved by the teaching assistants through computer management could be used to teach short seminars on topics of current interest. The seminars were smoothly implemented, appeared to make economic theory more understandable via practical situations, and maintained high student interest.

RECOMMENDATIONS

The research and development reported here demonstrated that a standard course could be individualized relatively simply, managed by computer, and maintain or somewhat enhance student performance, while freeing instructor time for seminars and tutoring. If the system could be adapted successfully for military technical training, many courses could be converted to an individualized format, thus saving student time and allowing more effective use of instructors as tutors and as supervisors of hands-on training. Therefore, it is recommended that a CMS-type system be field tested in a military setting for further test and evaluation. This effort should be designed to test the applicability of the methodology in converted current course materials and its effectiveness in training military students, while documenting conversion costs and cost avoidance.

REFERENCES

Alessi, S. M., Anderson, R. C., Anderson, T. H., Biddle, W. B., Dalgaard, B. R., Paden, D. W., Smock, H. R., Surber, J. R., & Wietecha, E. J. Development and implementation of the Computer-Assisted Instruction Study Management System (CAISMS) (NPRDC Tech. Rep. 74-29). San Diego, CA: Navy Personnel Research and Development Center, Feburary 1974. (AD-A780 516)

Alessi, S. M., Anderson, T. H., & Biddle, W. B. Hardware and software considerations in computer-based course management (Tech. Rep. No. 4). Urbana, IL: University of Illinois, Laboratory for Cognitive Studies in Education, November 1975.

Anderson, T. H., Anderson, R. C., Alessi, S. M., Dalgaard, B. R., Paden, D. W., Biddle, W. B., Surber, J. R., & Smock, H. R. A multi-faceted computer-based course management system (NPRDC Tech. Rep. 75-30). San Diego, CA: Navy Personnel Research and Development Center, April 1975. (a) (AD-A010 120)

Anderson, T. H., Anderson, R. C., Alessi, S. M., Dalgaard, B. R., Paden, D. W., Biddle, W. B., Surber, J. R., & Smock, H. R. A multi-faceted computer-based course management system. Proceedings of IFIP 2nd World Conference on "Computers in Education." Marseilles, France, 1-5 September 1975. (b)

Anderson, T. H., Anderson, R. C., Dalgaard, B. R., Paden, D. W., Biddle, W. B., Surber, J. R., & Alessi, S. M. An experimental evaluation of a Computer-Assisted Instruction Study Management System (CAISMS) (NPRDC Tech. Rep. 75-31). San Diego, CA: Navy Personnel Research and Development Center, April 1975. (a) (AD-A010 119)

Anderson, T. H., Anderson, R. C., Dalgaard, B. R., Paden, D. W., Biddle, W. B., Surber, J. R., & Alessi, S. M. An experimental evaluation of a computer-based study management system. Educational Psychologist, 1975, 11, 184-190. (b)

Anderson, T. H., Anderson, R. C., Dalgaard, B. R., Wietecha, E. J., Biddle, W. B., Paden, D. W., Smock, H. R., Alessi, S. M., Surber, J. R., & Klemt, L. L. A computer-based study management system. Educational Psychologist, 1974, 11, 36-45.

Anderson, R. C., & Biddle, W. B. On asking people questions about what they are reading. In G. Bower (Ed.), Psychology of learning and motivation, Vol. 9. New York, NY: Academic Press, 1975.

Barclay, J. R. The role of comprehension in the remembering of sentences. Cognitive Psychology, 1973, 4, 299-354.

Carson, S. B., Graham, L. L., Harding, L. G., Johnson, K. A., Mayo, G. D., & Salop, P. A. An evaluation of computer-managed instruction in Navy technical training (NPRDC Tech. Rep. 75-38). San Diego, CA: Navy Personnel Research and Development Center, May 1975. (AD-A012 638)

Dalgaard, B. R., Paden, D. W., & Anderson, T. H. Computer-based course management in the first course in economics. Proceedings of the Illinois Economic Association, 1976.

Felker, D. B. The effects of question type and question placement on problem solving ability from prose material. Pittsburgh, PA: American Institutes for Research, 1974.

Lloyd, E. K., Garlington, W. K., Lawry, D., Burgess, H. Evler, H. A, & Knowlton, W. R., A note on some reinforcing properties of university lectures. Journal of Applied Behavior Analysis, 1972, 5, 151-155.

Parsons, J. A. Personalized system of instruction: Theory, research, and practice. Urbana, IL: University of Illinois, undated.

Stifle, J. The PLATO IV architecture (CERL Rep. X-20). Urbana, IL: University of Illinois, Computer-based Education Research Laboratory, May 1972. (a)

Stifle, J. The PLATO IV student terminal (CERL Rep. X-15). Urbana, IL: University of Illinois, Computer-based Education Research Laboratory, June 1972. (b)

Stifle, J. The PLATO IV terminal: Description of operation (CERL Rep.). Urbana, IL: University of Illinois, Computer-based Research Laboratory, March 1973.

Watts, G. H., & Anderson, R. C. Effects of three types of inserted questions on learning from prose. Journal of Educational Psychology, 1971, 62, 387-394.